Addition, Suppression, and Inhibition in the Electrophoretic Deposition of Nanocrystal Mixture Films

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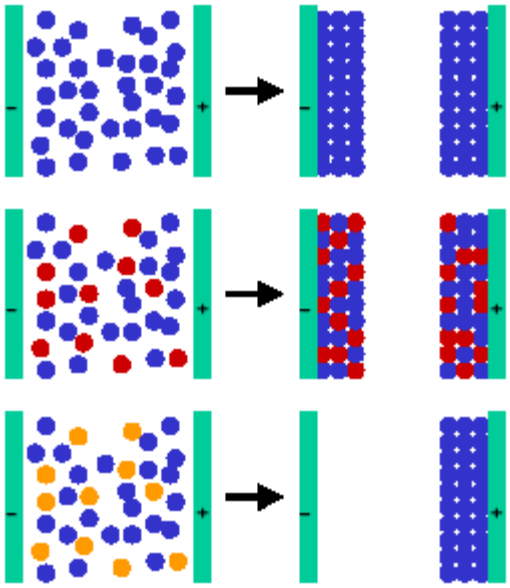
Nanocrystals in solutions can be attracted to an electrode with an applied voltage, when the nanocrystals are charged, and then deposit to form a film composed of nanocrytals; this is one form of electrophoretic deposition. For CdSe nanocrystals in the mixture, films composed of CdSe nanocrystals form on both electrodes (top figure, blue dots). When iron oxide nanocrystals (red dots) are added to this solution, films composed of both CdSe and iron oxide nanocrystals form on both electrodes (middle figure); this is additive behavior, and is quite expected. In contrast, when gold dots (yellow dots) are added to the CdSe nanocrystals, deposition occurs only on the positive electrode, and only CdSe nanocrystals are deposited (lower figure, suppression). With lower and lower concentrations of gold nanocrystals in the solution, a film of increasing thickness - of only CdSe nanocrystals - starts to form on the negative electrode (suppression). This unexepected non-additive behavior is likely due to complex chemistry between the nanocrystals in solution. This work was done by Prof. Irving Herman, with Prof. Rastislav Levicky, Prof. Stephen O'Brien and other collaborators in the Columbia University MRSEC.



Initial solutions (left) and final electrophoretically deposited films (right, with solution removed) for the three cases described. (Note that the nanocrystals in the films are not really ordered arrays.)